Gritti-Stokes Amputation in the Trauma Patient: Tips and Techniques

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Introduction

The Gritti-Stokes amputation establishes osseous continuity between the patella and the distal part of the femur with maintenance of the intact prepatellar soft tissues.

A retrospective review showed that patients with a Gritti-Stokes amputation, as compared with those with a transfemoral amputation, had increased limb length, improved patient-assessed outcomes, and an increased rate of unassisted walking while wearing the prosthesis¹. This procedure establishes osseous continuity between the patella and the distal part of the femur remaining after transection, while maintaining the intact prepatellar soft tissues. The technique has several potential advantages over transfemoral amputation. First, the remaining limb length is significantly longer with the Gritti-Stokes technique, which can help with transfers and sitting balance, particularly in bilateral amputees^{1,2}. Second, the superior genicular arterial system is maintained, improving blood supply to the soft-tissue flaps and potentially leading to increased healing rates^{3,4}. Last, the need for mobilization aids appears to be decreased with this technique, with improved patient-reported subjective outcomes¹.

This procedure is done in eight stages:

- Step 1: Preoperative planning
- Step 2: Flap design
- Step 3: Soft-tissue dissection
- Step 4: Distal femoral and patellar cuts
- Step 5: Posterior dissection
- Step 6: Patellofemoral arthrodesis
- Step 7: Soft-tissue closure
- Step 8: Postoperative management

Step 1: Preoperative Planning

As with all orthopaedic surgery, preoperative planning is essential to obtaining an optimal outcome with this procedure.

The patella and prepatellar soft tissue must be out of the zone of injury to perform this procedure.

Any distal infected or contaminated tissues need to be covered and isolated during this procedure.

For best results, have a licensed prosthetist help to design the amputation stump.

Step 2: Flap Design

Use an asymmetric flap consisting of the undisturbed prepatellar soft tissues and rotate it posteriorly to achieve closure.

Outline the anterior aspect of the flap on the anterior aspect of the tibia at the level of the tibial tubercle in a transverse manner (Fig. 1). Continue the outline in a caudad-to-cephalad direction in the midline of the knee and distal part of the femur.

Outline the transverse posterior aspect of the flap, which is located approximately at the level of the planned femoral cut.

Create a smooth curve between the anterior and posterior flaps to minimize problematic “dog ears” during definitive skin closure.

Step 3: Soft-Tissue Dissection

Keep soft-tissue dissection subperiosteal or intratendinous to minimize blood loss and postoperative pain.

If a tourniquet is used, exsanguinate by elevating the limb.

Incise the skin, subcutaneous tissue, and deep fascia of the anterior flap in a full-thickness manner (Figs. 2-A and 2-B).

Elevate the patellar tendon, pes anserinus tendons, and iliotibial band insertions off the proximal part of the tibia in a subperiosteal manner, working from distal to proximal.

Place a single large-gauge suture through each of the stumps of these soft-tissue structures to allow for later identification.

Continue proximally and enter the knee joint, sharply sacrificing the cruciate and collateral ligaments.

Elevate the synovium off the femur in a sharp manner to expose the distal part of the femur.

Perform a total synovectomy to eliminate post-operative effusion from remaining synovial tissue (Fig. 3).

Identify, individually ligate, and transect the saphenous nerve and long saphenous vein over the medial aspect of the distal part of the thigh.

Step 4: Distal Femoral and Patellar Cuts

Use a high-speed saw to transect the femur and patella.

Identify the adductor tubercle on the postero-medial aspect of the distal part of the femur.

Elevate the posterior soft tissue from the femur in this region using blunt and/or sharp dissection.

Use a saw to create an angled femoral cut of approximately 10° to 15° distal to the adductor tubercle, from anterior-distal to posterior-proximal, to resist patellar dislocation forces.

Hold the patella securely with towel clips on the patellar and quadriceps tendons, and use a wide saw blade to make a flat patellar cut (Fig. 4).

The patellar cut should be parallel to the anterior surface of the patella; any later adjustments to the initial cut can be made with the power saw or even a manual bone rasp.

Irrigate the surgical site with a copious amount of sterile fluid to remove any cartilage or osseous debris from the femoral and patellar cut surfaces.

Step 5: Posterior Dissection

Carry out posterior dissection in a methodical manner, with individual identification and ligation of all neurovascular structures.

Retract the cut femoral condyle bone fragment distally and maintain the gastrocnemius tendon origins posteriorly.

Identify and separate the tibial nerve, common peroneal nerve, and popliteal vessels.

Individually ligate the popliteal vessels and any visible branches at the level of the femoral cut.

Individually ligate the common peroneal and tibial nerves to eliminate blood flow to the nerve ends via the vasa nervorum (Fig. 5-A).

Perform an intraneural injection of local anesthetic with epinephrine to minimize symptomatic neuroma formation (Fig. 5-B).

Sharply transect each nerve distal to the ligation, allowing each to retract proximally.

Sharply transect the biceps femoris tendon at the distal myotendinous junction.

Cut through the remaining subcutaneous tissue and skin posteriorly.

Remove the transected part of the limb from the table.

If a tourniquet was utilized, deflate it at this point and ligate or cauterize any bleeding sources.

Step 6: Patellofemoral Arthrodesis

Suture the patella to the distal part of the femur using six drill holes and nonabsorbable suture.

Use a 2.0-mm drill bit to create six drill holes in the remaining patella. Drill from the freshly cut surface toward the anterior surface.

Use the same drill bit to create six evenly spaced drill holes in the distal aspect of the femur, approximately 1 cm from the distal end of the remaining bone.

Place a single large nonabsorbable suture, such as number-5 Ethibond (Ethicon, Johnson & Johnson, New Jersey), through each of the patellar drill holes (Fig. 6-A).

Thread the suture nearest the superior pole of the patella through the anterior femoral drill hole and use a hemostat to clamp each suture end together.

Continue threading each of the patellar sutures through the remaining femoral holes, working toward the inferior patellar suture and posterior femoral drill hole (Fig. 6-B).

While holding the patella against the distal part of the femur, tie the sutures sequentially from anterior to posterior.

Step 7: Soft-Tissue Closure

Close the remaining soft tissue, including the posterior musculature, subcutaneous layer, and skin, in a layered fashion.

Irrigate the surgical site with additional sterile fluid to remove any remaining debris.

Suture the pes anserinus tendons to the biceps femoris tendon and iliotibial band over the distal posterior aspect of the patellofemoral arthrodesis, overlying the patellar tendon.

Suture the posterior thigh musculature to the patellar tendon.

Close the subcutaneous tissue in an interrupted manner.

Close the skin using simple interrupted sutures, making sure to minimize the skin damage from rough handling; the skin should close easily without substantial tension on the skin edges (Fig. 7-A).

Clean the stump and cover with a soft sterile dressing (Fig. 7-B).

Step 8: Postoperative Management

Postoperative care should be done in conjunction with a prosthetist to obtain optimal outcomes.

Postoperative care should be done in conjunction with a prosthetist to obtain optimal outcomes. The soft-tissue dressing is maintained in place until the sutures are ready to be removed, typically at two to three weeks postoperatively. Compressive stump dressings, or stump shrinkers, are then utilized over the following four to six weeks until a weight-bearing prosthesis is fitted. Alternatively, a temporary, non-weight-bearing prosthesis can be utilized in this time period if the surgeon or patient wishes. Full weight-bearing should be delayed until patellofemoral fusion is evident radiographically as well as clinically.

Results

The Gritti-Stokes amputation technique appears to be a potentially valuable addition to the amputation surgeon's armamentarium. As shown in our recent critical evaluation of this technique in a trauma population, several outcomes and variables were improved as compared with those following a transfemoral amputation¹. The patients treated with the

Gritti-Stokes procedure had a significantly increased rate of walking wearing the prosthesis without any assistive devices as well as significantly improved patient-reported scores on the Sickness Impact Profile questionnaire. The operative time for this technique was significantly increased over that required for the transfemoral amputation (140.5 versus 108.8 minutes), but residual femoral length was significantly greater in the Gritti-Stokes group (46.1 versus 34.6 cm).

What to Watch For

Indications

A traumatic lower-extremity injury at the level of, or distal to, the knee that is deemed non-salvageable but is associated with an intact prepatellar region

A dysvascular extremity with distal gangrene requiring amputation

Contraindications

Substantial injury to the prepatellar soft tissue

An infected knee

A prepatellar infection

Pitfalls & Challenges

Proper flap creation can be a challenge if local soft tissue has been injured or has previous scars.

Creation of the femoral cut at the appropriate level is key, as the patella will be larger than the distal part of the femur if the cut is made too proximal.

The femoral cut must be done in an anterior-to-posterior direction, with a cephalad-directed angle of 10° to 15° to reduce the possibility of patellofemoral dislocation.

Careful attention must be paid to the technique of the patellofemoral arthrodesis, as the sutures must be snug and fastened correctly to achieve appropriate compression at the arthrodesis site.

There should be a discussion with a licensed prosthetist prior to surgery to ensure that it will be possible to craft an appropriate prosthesis for the healed limb.

Clinical Comments

What differences have you seen with this procedure as compared with knee disarticulation?

Have you encountered any issues with prosthetic fitting or wear with this amputation technique?

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Figures

Fig. 1

Drawing illustrating the outlined flaps and the beginning of the skin incision. The purple line represents the desired skin incision, while the blue line shows the desired osseous cuts.

Fig. 2-A

Clinical photograph showing the flaps and the beginning of the skin incision

Fig. 2-B

Full-thickness flaps are created anteriorly; the iliotibial band insertion is held in the forceps prior to a tag suture being placed.

Fig. 3

A complete synovectomy should be performed during the procedure, with all synovial tissue removed to minimize the risk of postoperative effusion.

Fig. 4

The patella is being stabilized with sharp clamps while a freehand saw-blade cut of the patella is made. The retropatellar surface should be made parallel to the palpated anterior surface.

Fig. 5-A

The posterior neurovascular structures should be individually identified, separated, and ligated in a methodical manner.

Fig. 5-B

The nerves to be transected are ligated and infiltrated with local anesthetic in an effort to minimize symptomatic neuroma formation.

Fig. 6-A

The nonabsorbable suture is placed through each of the patellar drill holes.

Fig. 6-B

Each of the sutures is matched with its corresponding hole in the distal part of the femur, and all are passed through their respective drill holes. They are then sequentially tied while compression is used to hold the patella in place.

Fig. 7-A

The skin is closed with simple sutures, ensuring that there is no substantial tension on the flap edges.

Fig. 7-B

The stump should be well-rounded with a well-fixed patellofemoral arthrodesis. The suture line and subsequent scar are posterior and away from any sites of potential end-bearing.

Fig. 1

Fig. 2-A Fig. 2-B

Fig. 3

Fig. 4

Fig. 5-A Fig. 5-B

Fig. 6-A Fig. 6-B

Fig. 7-A Fig. 7-B